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The costs and benefits of high speed vessels relative to traditional C-17 military airlift

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MBA PROFESSIONAL REPORT

The Costs and Benefits of High Speed Vessels Relative to Traditional C-17 Military Airlift

By: Thomas Strenge and Kevin W. Ralston

December 2003

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13. ABSTRACT (maximum 200 words)

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The results indicate that in ranges of up to 1,500 nautical miles, HSVs have a speed advantage over C-17 airlift. One HSV can move a single battalion of Marines, whereas AMC requires seventeen C-17 aircraft, a number rarely available for such a mission. Additionally, during routine FY03 operations, *WestPac Express* incurred costs of $12 million. This saved $8.7 million compared to an estimated AMC cost of $20.7 million. The study also recommends bareboat leasing to take advantage of the increased operational flexibility. In the absence of significant cost differences, civilian manning is superior to military manning due to organizational fit. The study concludes with a recommendation that MSC institutionalize HSV service in the III MEF AOR and expand the service to all other maritime theaters.

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THE COSTS AND BENEFITS OF HIGH SPEED VESSELS RELATIVE TO TRADITIONAL C-17 MILITARY AIRLIFT

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Submitted in partial fulfillment of the requirements for the degree of

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LIST OF ACRONYMS

III MEF	Third Marine Expeditionary Force
ABC	Activity-Based Costing
AMC	Air Mobility Command
AO	Area of Operations
AOR	Area of Operations
COTS	Commercial Off The Shelf
DoD	Department of Defense
FSC	Future Surface Combatant
HMAS	Her Majesty's Australian Ship
HMMVWs	High Mobility Multipurpose Wheeled Vehicle
HSF	High-speed ferries
HSS/AP ESC	High Speed Shipping / Agile Port Executive Steering Committee
HSS/AP AOG	High Speed Shipping / Agile Port Action Officers Group
IBCT	Interim Brigade Combat Team
LCS	Littoral Combat Ship
LST	Landing ship tank
LSV	Logistics Support Vessel
NDI	Non-developmental Items
OSD AT & L	Office of the Secretary of Defense for Acquisition, Technology and Logistics
PEO	Program Executive Officer
SWOT	Strength Weakness Opportunity Threat
TACOM	Tank and Automotive Command
TSV	Theater Support Vessel
USS	United States Ship
USTRANSCOM	United States Transportation Command
VISA	Voluntary Intermodal Sealift Agreement

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Many have assisted us in this project, both through their prior research and their direct help. We would like to thank especially Mr. John Hume, MSC Project Officer for the *WestPac Express*, who gave us an opportunity to work on a real world Navy problem. Also, we would like to thank Captain Ken Kujala, Master of *WestPac Express*, and MAJ Samuel K. Howard, USMC, HSV Project Officer for III MEF. Their assistance during research in Okinawa and in Monterey helped us understand the operational employment of the *WestPac Express*, as well as the needs of the end customer: Third Marine Expeditionary Force. Additionally, we would like to thank CAPT Jeff Kline, USN, who provided funding for research. Finally, we would like to thank our patient co-advisors whose direction and editing steered this project to its successful conclusion. Without NPS Professors Kevin Gue and David Henderson, our educational voyage may have been lost at sea.

Best wishes,
Kevin Ralston, LT, USN
Thomas Strenge, LT, USN

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I. INTRODUCTION

A. HIGH SPEED FERRIES

New technologies have emerged in recent years that will alter the way we bring our military forces to the fight. These technologies, merging with operational concepts such as Sea Strike, Sea Shield, and Sea Basing, inspire the Navy's transformation efforts. Enhanced naval capabilities are essential to these concepts and will alter the way we operate on the high seas. High Speed Vessels (HSVs) are one of the platforms that will push our transformational efforts onward.

High-speed ferries (HSF) and catamaran-hulled ships have been used primarily as passenger ferries in the commercial sector. They have proven to be reliable, cost efficient, and quicker than traditional mono-hulled ferries, and they offer passengers a comfortable ride. Whereas most mono-hulled ships travel at speeds around 15 knots, HSVs reach top speeds of over 40 knots and travel at sustained speeds of over 30 knots when fully laden. In short, HSVs double the speed at which current maritime technology travels.

In 1999, the Royal Australian Navy used a HSF, the HMAS Jervis Bay, to support its forces while conducting humanitarian operations in East Timor. The impressive performance of the HMAS Jervis Bay as a logistics support vessel (LSV) gained the attention of military officials within DoD. Not only did the HMAS Jervis Bay perform exceptionally well, but also it required only minimal alterations in order to undertake a military mission.[1] Most important, HMAS Jervis Bay was commercial off-the-shelf technology (COTS), allowing defense establishments to attain the capability without paying R&D costs. Ironically, the impetus for the charter of HMAS Jervis Bay was the unavailability of two recently purchased former US tank landing ships (LSTs). The vessels had been purchased to provide the Australian army with an expeditionary capability and were undergoing refit.[2] In 2001, the U.S. Navy and Army leased a HSF manufactured by Incat of Australia. Each service was given time to conduct operational tests and evaluate the vessel. The Navy is interested in having HSVs fulfill many roles while the Army is interested in their intra-theater lift capabilities. The U.S. Marines also have an interest in HSV technology. III Marine Expeditionary Force (III MEF), located in Okinawa, Japan, conducts training throughout the Western Pacific region. Previously III MEF relied upon the US Air Force's Air Mobility Command (AMC) to shuttle troops

[1] Higgins and March, pg 12.

from garrison to training grounds and exercises in Guam, Thailand, Korea and the Japanese mainland 80 percent of the time. [3] To move a Marine battalion requires seventeen C-17 lifts. However, sufficient aircraft to move the unit in one lift were usually not available. Consequently, such a mission would typically take fourteen days. With the availability of an organic asset such as HSV, III MEF acquired the capability to move a Marine battalion with its equipment within theater more quickly and more efficiently than airlift, reducing the time required for such moves to four days.

Although the III MEF experience has been positive, the decision to acquire new technologies such as HSV must be backed by solid analysis to ensure the right capability is purchased for the right reasons at the appropriate price. Based upon an accurate analysis, DoD's acquisition of new technologies must ensure that the American taxpayer receives equipment that enhances the military's capabilities and makes sense financially. Before investing significant time and money into furthering the use of HSVs in DoD, sufficient analysis must show that fast sealift for DoD is the appropriate choice for the future.

B. AREA OF ANALYSIS

III MEF, due to its location, has training requirements that preclude it from conducting all its training on the island of Okinawa. As a result, considerable travel to and from training ranges is required. Since February 2002, the Austal-built HSV *WestPac Express* has served III MEF to take troops to and from training ranges and international exercises located throughout the theater. Prior to the charter of *WestPac Express*, III MEF relied heavily upon AMC for transportation of personnel and equipment.

Military Sealift Command (MSC) requires a cost-benefit analysis to determine if the purchase or lease of more HSVs is warranted. HSVs would act as a solution to medium-lift intra-theater transportation needs. However, at what point does the use of an HSV become more cost-efficient than AMC flights?

1. Research Questions

1.1 Is HSV a better choice for intra-theater lift than AMC?

1.2 Should DoD buy or lease?

1.3 Should the crew be military or civilian?

---

[2] Snyder

[3] Dugan

1.4 What other theaters require an intra-theater lift platform? How many HSVs does DoD need?

C. SCOPE AND METHODOLOGY

A cost-benefit analysis is important in any business process. Costs are generally thought of as quantitative, while benefits may be both quantitative and qualitative. All factors, quantitative and qualitative, must be factored in. To estimate the value of HSVs, we compared *WestPac Express* data to the closest supplement: the Air Force C-17. The analysis is based upon cost data provided by MSC, personal research, and in-depth analysis conducted by third parties.

As the organization responsible for chartering *WestPac Express*, MSC has collected large volumes of data: financial data, logistical data, fuel records and port costs. We draw conclusions from the evaluation of *WestPac Express* and assume other vessels of similar size and capability would have approximately the same costs and benefits.

Also, other relevant DoD experience with HSVs is considered. The goal is to draw lessons from these specifics and form a conclusion regarding the suitability of HSVs to MSC needs, not to justify WestPac Express.

A limitation of the study is the lack of comparable C-17 data. It requires seventeen C-17s to equal one *WestPac Express* lift. Rarely is that number of aircraft available at one time. AMC can augment missions with other types of aircraft; however, the C-17 is considered the current and future backbone for airlift.

A further limitation is the lack of one consistent definition of what constitutes intra-theater and inter-theater lift. For example, AMC considers C-130s as its primary AMC intra-theater lift asset, however, they lack the size and speed of the C-17 and can move very little of a battalion's heavy gear. HSVs, just like C-17s can be refueled and have circumnavigated the Globe and have no difficulty crossing oceans. For the purpose of this study, intra-theater lift is considered to not exceed 2,500 nautical miles (NM). This is twice the un-refueled range of the WestPac Express and describes the expected operating environment of current HSVs. Also, it eliminates from consideration movement of materiel from the United States to East Asia or Europe, which are areas of responsibility for different theater commanders.

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II. BACKGROUND

A. HISTORY

In 1999, Australia accepted the lead in a United Nations peacekeeping mission in East Timor. Due to the unavailability of recently purchased American LSTs, which were undergoing refit, the Australian military lacked adequate sealift capability to support its expeditionary force. The Australian military took the unorthodox step of leasing a High Speed Vessel (HSV) and commissioned her into service as HMAS Jervis Bay. During her two years of service, HMAS Jervis Bay routinely shuttled back and forth on the 430-nautical-mile route between Darwin, Australia and Dili, East Timor, sometimes conducting three runs per week. The program was seen by the Australian military as a success and introduced a new capability to western militaries— fast sealift. [4]

III Marine Expeditionary Force (MEF), forward deployed in Okinawa, was the first U.S. force to embrace this capability. Via MSC, a time charter was signed with the Australian manufacturer Austal for the HSV *WestPac Express*. The experience gained through this program and other US government HSV initiatives indicates that HSVs provide a solution to medium lift, intra-theater requirements.

1. MSC Background

The Military Sealift Command (MSC) is one of three component commands of the US Transportation Command (TRANSCOM), which is responsible for meeting the transportation needs of the Department of Defense (DoD). MSC oversees the maritime component. Its mission is "to provide ocean transportation of equipment, fuel, supplies and ammunition to sustain U.S. forces worldwide during peacetime and in war for as long as operational requirements dictate."[5]

B. WESTPAC EXPRESS

The *WestPac Express* is capable of sustaining 36 knots while transporting 500 dead weight tons.[6] *WestPac Express* has proven its ability to transport 400 tons of equipment and 370 Marines from Okinawa to Guam in approximately 40 hours. It is able

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[4] Polson
[5] MSC web site: [http://www.msc.navy.mil/N00P/mission.htm]
[6] Austal web site: [http://www.austal-ships.com/range/military.cfm]

Table 1: WestPac Express Characteristics

Range	1250 nm
Max Deadweight	750 tonnes[7]
Cargo Space	40,000 sq ft.
Length	331ft
Beam	87 ft
Draft	14 ft
Speed	37kts
Engines	4 X Caterpillar diesels
Propulsion	Kamewa water jets
Vehicles	152 HMMWVs

Source: Austal-ships.com

to carry 970 Marines and 750 tonnes of equipment in a single load. In order for AMC to move the same cargo, it would require 14 to 17 C-17 aircraft over a period of approximately 14 to 17 days.[8]

III MEF uses the vessel as an intra-theater lift platform to transport troops and equipment from garrison to training ranges throughout the Western Pacific region.

C. C-17 CHARACTERISTICS

The C-17 does the majority of heavy lifting for AMC over both inter- and intra-theater distances. To move a Marine battalion equivalent, or a *WestPac Express* full load, requires the following: 17 C-17s to move 531 short tons (roughly equal to 420 short tons of cargo and 111 short tons for 970 passengers).[9] Its procurement cost is $236.7

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[7] tonne is a metric unit of mass equal to 1000 kilograms or approximately 2204.623 pounds avoirdupois
[8] NWDC web site: [http://www.nwdc.navy.mil/HSV/ConceptHSV.asp]
[9] e-mail, MAJ Howard, III MEF

million (FY98 constant dollars)[10]. It has a global range with in-flight refueling and can travel at a speed of 450 knots at 28,000 feet.[11]

Table 2: C-17 Characteristics

Range	Global with in-flight refueling
Load	170,900 lbs or 102 troops
Cargo Space	88 ft x 18 ft x 12 ft 4 in
Length	174 ft
Wingspan	169 ft 10 in
Height	55 ft 1 in
Speed	450kts at 28,000 ft
Engines	4 X Pratt & Whitney F117 turbofan
Thrust	44,440 lbs, each engine

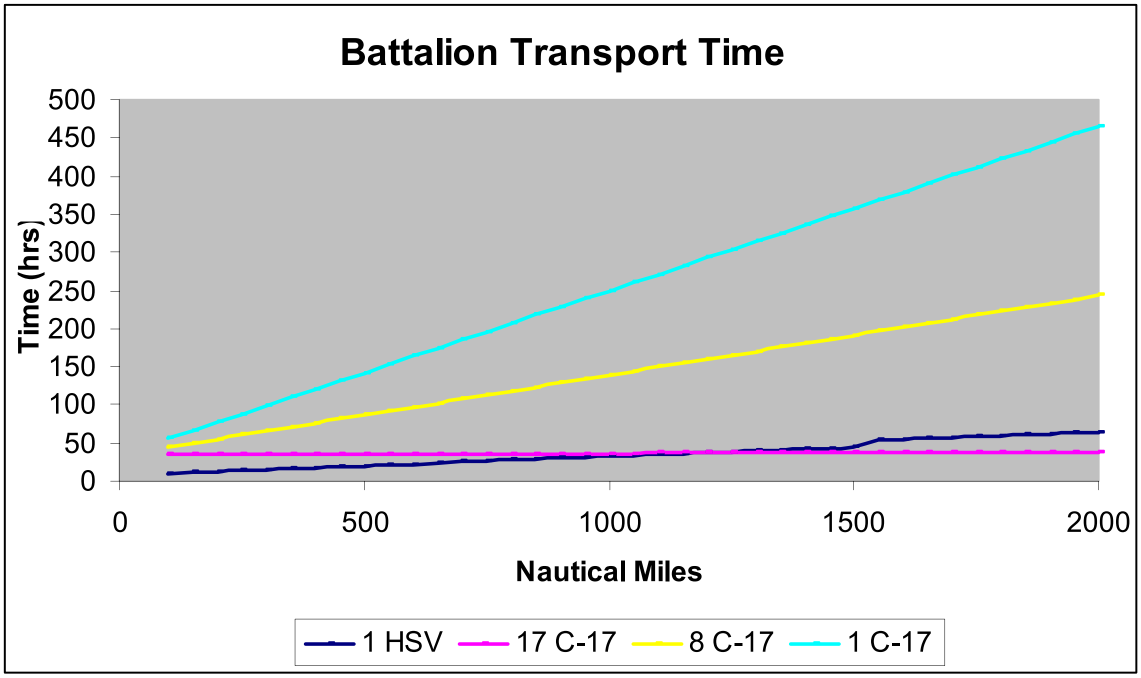
Source: US Air Force Fact Sheet

D. TIME CONSIDERATIONS

When comparing two modes of transportation, total cycle time should be considered. How long does it take assembled Unit X to travel from Garrison A to Country B and reassemble as a fighting unit? Using this holistic approach as opposed to merely comparing platform speeds, an HSV transporting a Marine battalion will take less time than seventeen C-17s in distances up to 1250 nautical miles. For example, III MEF planners routinely assume four hours for an embark operation. It may take longer based on the complexity of the load and the experience of the handling crew. It can take less than an hour if the load consists of rolling stock and personnel only. Assuming a fully loaded HSV speed of 42 knots and C-17 speed of 450 knots, as well as a combined harbor embark/debark time of 8 hours versus a combined airport embark/debark time of 2 hours per plane, the HSV will be faster for any distance up to 1250 miles. However, AMC rarely has seventeen C-17s available at a time for a routine airlift. The total active duty, Air National Guard inventory is only 64, with a goal of 134.[12]

[10] U.S. Air Force fact sheet
[11] ibid
[12] ibid

Figure 1: HSV – C-17 speed comparison



Furthermore, AMC touts full and partial mission availability rates for the C-17 of 74.7 and 82.5 percent, with "only 20 aircraft maintenance man-hours per flying hour".[13] This makes it the most reliable of AMC assets in its inventory. The *WestPac Express* has "never missed an operational requirement due to mechanical failure"[14] and requires only 0.45 maintenance hours per engine hour[15].

C-17 travel, even if all 17 airplanes are available (in most routine missions they are not), is severely constricted by the limitations of the airport as a transportation node. For example, most airports have at most two runaways, allowing only two airplanes to land or take off at a time. Also, the administrative task of dividing the battalion and loading onto the aircraft is much more complicated and time-intensive versus the relatively straightforward loading of the HSV (walk-on, walk-off). III MEF experience with the *WestPac Express* indicated a reduction in time allotted for moving a Marine Battalion from fourteen days to four days.

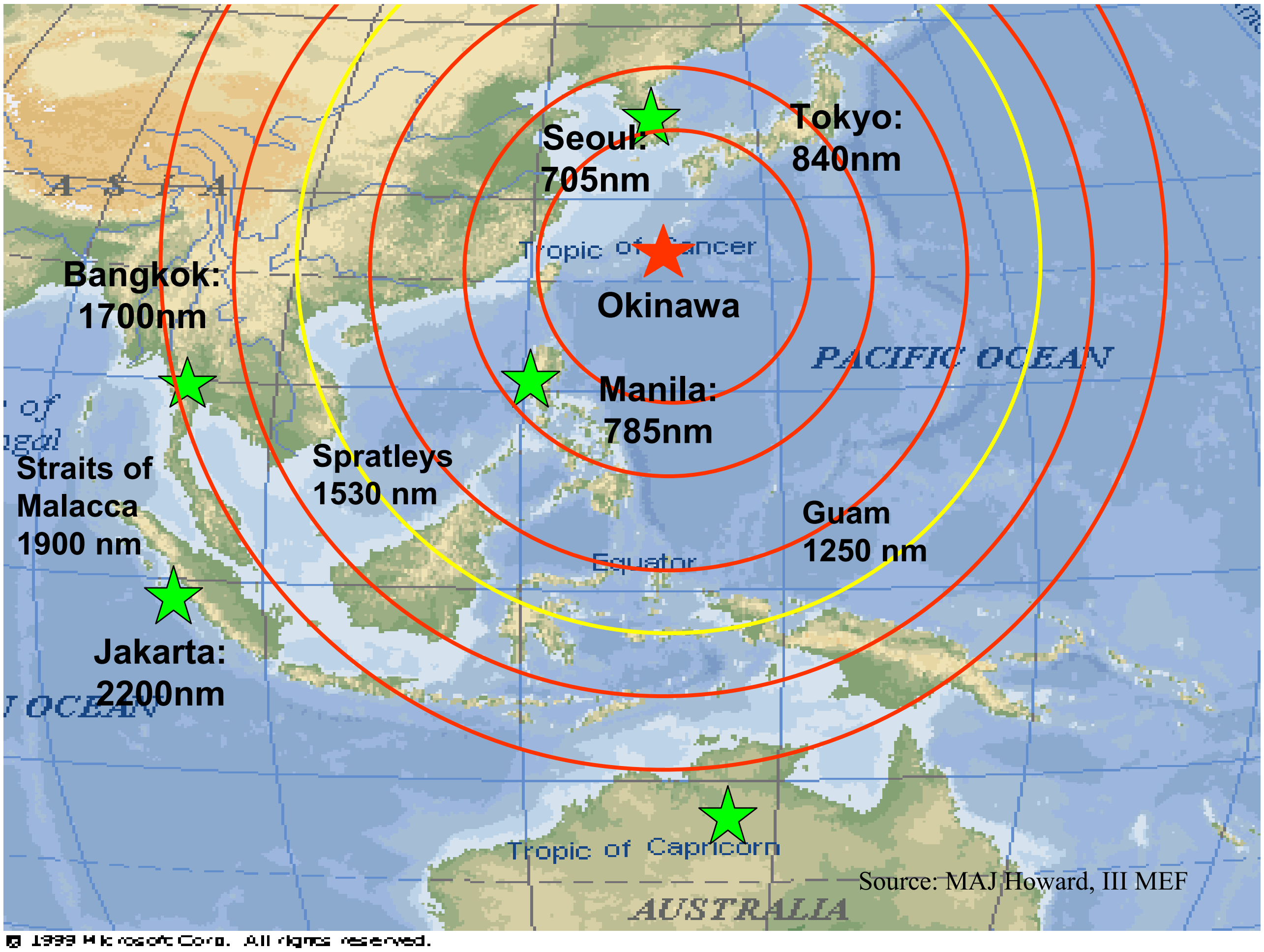
[13] ibid
[14] interview with MAJ Howard, III MEF
[15] interview with Captain Ken Kujala, *WestPac Express*

Source: US Air Force

Also, in the case of III MEF, the *WestPac Express* had an additional time saving benefit. Travel time to and from Kadena Air Base is eliminated. The HSV *WestPac Express* can load at Kin Red pier, which is directly adjacent to the Marine Garrison, and hence the Marines can save themselves a longer trip through congested Okinawan civilian traffic to Kadena. Time required per mission is thus reduced even further. Furthermore, the impact of U.S. military presence on the civilian population is reduced.

AMC airlift is superior when moving large numbers of personnel long distances. For example, moving personnel from the U.S. into Iraq quickly is accomplished most efficiently via airlift. Also, movement of small packages is done more efficiently via aircraft.

Figure 2: HSV WestPac Express operational radius



E. INCREASED FLEXIBILITY

The *WestPac Express* was designed for a Greek ferry operator who went bankrupt. Therefore it has some operational shortcomings that have been addressed in Incat's 112-m military design and Austal's 125-m design. These designs are slight modifications of the baseline model and have not resulted in over specialization of this platform. Over specialization is the biggest danger faced by non-developmental items (NDI). It is the growth of military requirements placed on commercial products. The true benefit of an NDI is when the commercial role matches the military role. However, military planners are prone to ask for more capability, which leads to a cost increase. The more a product specializes to military demands, the greater the cost difference with a similar commercial item. An HSV is essentially a large, open platform that provides electricity and air conditioning. The *WestPac Express* has a 4-m draft, making the vast majority of ports in the World accessible. The *WestPac Express* can carry every item in the Marine Corps inventory with the exception of fixed wing aircraft, the H-53 helicopter and the M1-A1 tank. Its stern facing ramp and lack of heavy anchors limit the *WestPac Express*. Heavy anchors are necessary to conduct a med moor (the ship moors perpendicular to the pier with its stern closest; this is a common practice in the Mediterranean, but requires two solid anchor points). Without them, the *WestPac Express* requires an L-shaped pier to load/unload. The 112-m HSV design corrects these limitations. With the exception of fixed wing aircraft, it can carry every piece of equipment in the Marine Corps inventory and its slew able ramp obviates the need for an L-shaped pier. This will open up the majority of the World's ports to HSV service.

Source: Global Security .org

Additionally, the *WestPac Express* has been able to conduct at-sea refueling using the astern refueling method, thus increasing operational range. The 112-m is not expected to add a Standard Tensioned Refueling Alongside Method rig. However, the 112-m design adds a flight deck, thus further increasing operational uses. The mechanical reliability of the *WestPac Express* has been excellent. It essentially has not missed operational requirements due to mechanical failure.[16] This is much improved over AMC performance. The only real limitation is weather. A 4-m or greater head sea (a head sea refers to the situation when the ship's bow "heads" into the waves) does not allow *WestPac Express* operations. This is equivalent to Sea State 6. Additionally, the lack of draft translates into greater susceptibility to wind. Sustained 25-knot winds can preclude loading and unloading operations. As an aside, the *WestPac Express*' ramp provides a lot of stability to the ship when extended on the pier. When loading helicopters, two forklifts have to lift the ramp to a level parallel with the main deck because the angle is too steep to push the helicopter up the ramp. Instead, a crane lifts the helicopter onto the raised ramp. However, due to stability considerations this action is possible only in virtually windless weather conditions.

[16] Conversation with Captain Ken Kujala, *WestPac Express* and MAJ Howard, III MEF

III. FINANCIAL CONSIDERATIONS

A. COSTS

The financial data includes a breakdown of charter costs, fuel costs, port costs and overhead for the *WestPac Express*. Charter costs are considered fixed costs in that they are incurred whether the HSV is used or not. Charter costs include personnel costs and maintenance costs and are therefore a good baseline for buy-versus-lease comparisons. Variable costs are fuel costs and port costs and occur only when III MEF uses the HSV. MSC charges III MEF an overhead expense of 4 percent of the total costs, fixed and variable.

B. ANALYSIS METHODOLOGY

The Total Fixed HSV costs added to Total Variable HSV costs divided by the AMC price per passenger-mile determines how many passenger-miles the HSV has to travel for the total cost of the HSV to equal AMC cost. A passenger-mile is the product of passengers and miles moved. For example, moving 1 passenger 100 miles equals 100 passenger-miles; moving 5 passengers, 20 miles, equals 100 passenger-miles, etc

The Total Fixed HSV costs added to Total Variable HSV costs divided by the AMC price per lb-mile determines how many lb-miles the HSV has to travel for the total cost of the HSV to equal AMC cost. For ease of analysis, we then divided by 2000 to convert to short-ton-miles. A short-ton-mile is the product of short tons and miles moved. For example, moving 1 short ton 100 miles equals 100 short ton-miles; moving 5 short tons, 20 miles, equals 100 short ton-miles, etc.

C. FINANCIAL BENEFITS

Analysis of *WestPac Express* financial data indicated the following:

In FY02, the HSV accumulated 10.5 million passenger-miles and 8.1 million short ton-miles at a cost of 8.2 million dollars. The AMC cost would have been 9.3 million dollars, thus resulting in savings of 1.1 million dollars. The cost of the HSV did not equal the AMC cost (or break-even) until 34.6 million passenger-miles or 9.2 million short ton-miles.

Table 3: FY02 HSV break-even analysis

FY02	WestPac Express
Passenger-Miles	10,544,466
Short Ton-Miles	8,109,739
Cost – U.S. $	8,158,436

AMC Cost – U.S. $	9,329,418
Savings – U.S. $	1,170,982
Break-even	
Passenger-Miles or	34,583,982
Short Ton-Miles	9,163,412

In FY03, the HSV accumulated 17.3 million passenger-miles and 12.2 million short ton-miles at a cost of $12 million. This saved $8.7 million compared to an estimated AMC cost of $20.7 million. This indicates a break-even point of 50.6 million passenger-miles per year or 4.2 million passenger-miles per month (12-month basis). This is the equivalent of moving 500 personnel, 1000 miles, 8 times each month. The break-even point moving cargo is reached at 9.7 million short ton-miles per year or 810,000 short ton-miles per month (12-month basis). This is the equivalent of moving 400 short tons, twice, over a distance of 1000 miles.

Table 4: FY03 HSV break-even analysis

FY03	WestPac Express
Passenger-Miles	17,328,859
Short Ton-Miles	12,184,568
Cost – U.S. $	12,039,458
AMC Cost – U.S. $	20,739,789
Savings – U.S. $	8,700,331
Break-even	
Passenger-Miles or	50,595,101
Short Ton-Miles	9,708,872

A difficulty with this comparison is that it compares customer mixed costs with customer variable costs between two DoD assets. The cost of the HSV in this analysis is mixed: consisting of fixed costs (the charter) and variable costs (fuel and port costs). HSV fixed costs accrue whether the vessel is used or not. The additional variable costs account for up to 39 percent of monthly cost. AMC costs are variable costs based on flat rates charged per passenger-mile or lb-mile. These charges occur only when cargo is moved. Consequently, as use of the HSV goes up, the fixed costs become spread out over more passenger-miles or lb-miles, thus making it more attractive under high usage rates.

Second, we do not have a complete understanding of AMC costs. Activity-Based Costing (ABC) is an accounting method used to allocate all relevant costs to an activity. For example, intra-theater C-17 airlift would not only include the cost of fuel, maintenance, and aircrew, but depreciation of aircraft, cost of aircrew training, cost of airfields, etc. Naturally, AMC freight rates try to cover operating costs, but without ABC data we cannot have an accurate marginal cost per C-17 flight. Therefore, true costs in this analysis may be lower or higher.

D. FINANCIAL RISK

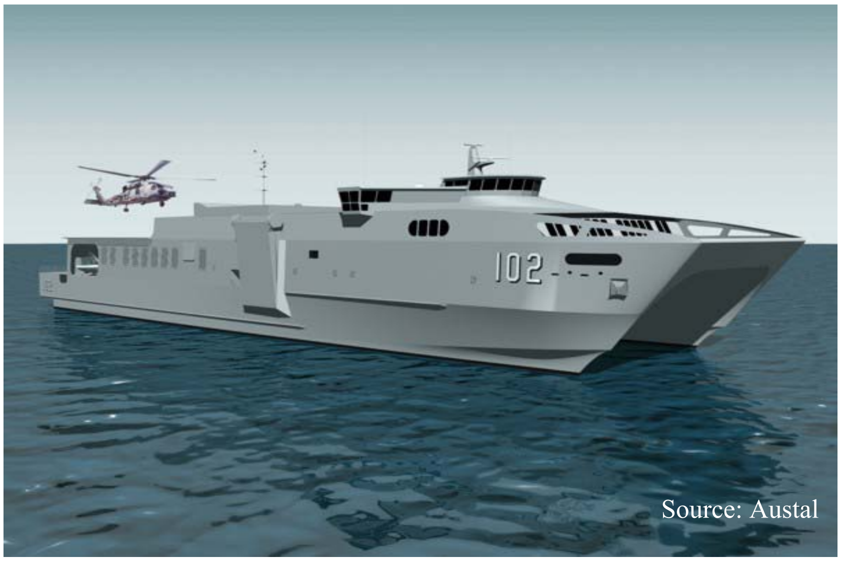
Statistical simulation software allows for assessment of financial risk. For example, by using FY03 financial information as the median value with a ten percent standard deviation and a normal distribution, a simulation can be run that indicates the result of possible cost variations. This indicated that the maximum break-even point for passenger-miles was 70 million. This equates to 5.8 million passenger-miles per month (12-month basis) and would require moving 500 personnel, 1000-nautical miles a dozen times. Break-even for cargo reached a maximum of 14 million short ton-miles per year. This translates to 1.2 million short ton-miles per month (12-month basis), or moving 400 short tons, 1000-nautical miles, three times. *WestPac Express* currently exceeds these levels.

E. OPPORTUNITY COST

Any cost-benefit analysis is not complete without considering opportunity cost, or what else could be purchased with the resources expended. HSVs offer some cost savings over traditional airlift, as well as time savings within their operating range. Additionally they offer capabilities not duplicated elsewhere in the US military. Finally, their essential nature as an open platform provides flexibility to innovative ideas not yet imagined. The purchase cost of a single HSV is approximately $100 million. The creation of a global HSV service (Okinawa, Med, Arabian Gulf/Red Sea, East Coast/Caribbean, West Coast/Hawaii) would cost an estimated $500 million. However, with leasing, this could be reduced to less than a third of that cost per year. Alternatively, $500 million could buy two C-17s. However, if the creation of an institutional HSV service can reduce the Air Force requirement for more C-17s by two, then the program would be paid for immediately.

[General] Handy [Commander, TRANSCOM] is on record as saying the currently planned procurement of only 180 C-17s is insufficient. He contended that the real requirement even under the old—and now outmoded—MRS-05 [DoD's most current Mobility Requirements Study] standard was more like 222 C-17s. Today's need would go even higher.[17]

DoD policy makers need to decide whether the resources expended on HSVs are a worthwhile investment or whether the money can bring more benefit elsewhere.



A 112-m HSV built to military transport specification would cost an estimated $100 million.[18] It would allow the movement of a Marine battalion including equipment. The range of the *WestPac Express* is 1,500 miles at 32 knots fully loaded, or 42 knots empty. The 112-m HSV is expected to exceed current HSV performance in all aspects.

F. LEASE OR BUY

Leasing allows for a reduction in technology risk. If a new technology makes HSVs less desirable or obsolete, all MSC has to do is not renew the lease. This provides an incentive to the owners to continuously update the vessels with new technology. Additionally, this same mechanism protects MSC from acquiring poor quality ships. An owner would not want to have a lease terminated because of poor material condition. Of course, the greater the expected improvement in technology, the higher will be the annual lease rate because the existing HSV will become more obsolescent.[19]

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[17] Tirpak, pg 25
[18] NWDC web site
[19] conversation with Dr. David R. Henderson, NPS

With a lease the thorny question of disposal is no longer a DoD issue. The recent furor about low-cost, but environmentally unsafe disposal of US military ships in India is a good example.[20] The Navy has 94 inactive ships with 65 slated for disposal. The current budget allocates only $5 million, with the estimated cost of U.S. disposal of a Spruance-class destroyer at $4 million. At that rate, it will take almost a century to get rid of yesterday's fleet, not to mention the hulks on hand at the Maritime Administration (MARAD). Ship disposal in the U.S. can be very expensive. . However, upon expiration of the lease, the HSV could simply be returned to the owner.

For leasing to be a viable option, HSVs have to be protected from "requirement creep." The military has a history of maximizing technology for its uses, not optimizing. For example, the Army made a requirement that its trucks had to be airdrop capable. This capability puts severe stress on a truck and required extensive re-engineering effort ranging from shock testing to making the vehicle fit into the aircraft. Very few trucks are air dropped by the Army, but all had to meet that requirement. This incremental increase in capability was purchased at a vast increase in cost.[21] HSVs face the same danger. Specialization will make HSVs more expensive and potentially less attractive as a transportation solution. Additionally, if the vessel becomes so specialized that the builder cannot return it to the commercial market, then leasing will no longer be an option. Incidentally, the Army's Tank and Automotive Command (TACOM) is leasing its TSVs.[22]

G. TIME CHARTER VERSUS BAREBOAT CHARTER

The *WestPac Express* is currently operated under a time charter, which gives MSC use of the HSV's transportation services for a specified period of time. This agreement is analogous to a limousine service, where the customer can call on the services of the car for the period paid for. The vessel is leased for III MEF by MSC from Austal. The actual operation of the *WestPac Express* has been subcontracted to Hornblower. The advantage here is that, just as with a rental car, DoD does not worry about maintenance or force protection. For example, Force Protection is required only when the Marines use the *WestPac Express* in operations. Additionally, maintenance is an issue for Austal and Hornblower, not MSC. This may not translate into significant cost savings, but reduces some of the hassle of "ownership".

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[20] *Shipbreakers, Revisited*
[21] COL Boudreau, USA, Ret., NPS
[22] Baumgardner

On the other hand, a time charter limits the operational flexibility of the vessel. For example, under a time charter, the *WestPac Express* falls under Coast Guard jurisdiction. For transporting HAZMAT, Coast Guard regulations are much more stringent than Navy regulations. For example, during a recent move of helicopters onboard the *WestPac Express*, air crew had to empty all the embarked aircrafts' JP-5 tanks. Furthermore, all embarked gear and vehicles had to be carefully inventoried.[23] Under a bareboat charter, this would not be the case. A bareboat charter is akin to a long-term automotive lease where the customer is responsible for all aspects of the vehicles maintenance and operation, but does not own it outright. Furthermore, a bareboat charter would allow the HSV for such innovative uses as hospital ship, special warfare mother ship, or mine warfare asset. These functions could not be accommodated under a time charter.

Under a bareboat charter, MSC would assume control of the vessel and provide for maintenance and force protection. On the other hand, this would allow for full integration of HSVs into the fleet. Secure communications can be installed; the full range of operational concepts can be executed and regulatory burdens can be reduced.

H. CIVILIAN CREW VERSUS MILITARY CREW

MSC handles maritime logistics for DoD. It does so with a mostly civilian work force. If MSC adopts the HSV as a logistics solution, we see no reason to treat it differently than its other logistic assets. This is in keeping with the outsourcing of most Navy logistic capabilities to MSC, which was accomplished both as a cost-saving measure and to allow the Navy to focus its efforts on war fighting. The *WestPac Express* currently operates with a crew of 14 civilians. *WestPac Express* FY03 annual personnel costs were $2.9 million.[24] The *Joint Venture*, a similarly sized vessel, has a crew of 40 military personnel**.** The main reason for manning differences lies in the specialization of Navy rates versus the versatility of MSC crewmembers. Also, a military crew implies a military command structure, which requires more organizational levels and more administrative support. Appendix E outlines the rank distribution for a notional military *WestPac Express* crew. Using the Annual DoD FY04 Composite Rate[25] indicates a military crew cost of $2.5 million, or $0.4 million less than civilian manning. However, slight changes in the distribution of military pay grades could easily narrow this gap.

Traditionally, maritime logistic support to a war zone has not been an issue. MSC has had no difficulties in finding civilian crews.[26] War bonus costs involving a doubling of regular salaries could become significant for long conflicts.[27] However, Operation Iraqi Freedom lasted approximately two months. Though the current global climate is marked by increases in low-intensity conflict and random terrorism, future US wars can be assumed to be both rare and short.

From an organizational viewpoint, it is hard to imagine a Navy officer seeking service onboard an HSV. The military has demonstrated lower promotion opportunity for line officers not serving in line positions. Service aboard a non-combatant would hurt promotion chances for most surface line officers. Also, as an organization, the Navy does not like to focus on the running of its support functions, instead preferring to send its sailors to combatants. All services struggle with this and it lies at the heart of the creation of a separate TRANSCOM, AMC and MSC. Furthermore, a military crew would labor under OP-TEMPO restrictions, which limit the number of underway days for a fleet unit. A MSC asset with a civilian crew would not have to contend with this limitation.

In case of special missions such as mine warfare or special warfare mother ship, the vessel could be turned over to a crew of reservists.

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[23] *WestPac Express* visit, Naha port, 29OCT03
[24] *WestPac Express* Operating Costs, 12 Nov 2003
[25] Military Composite Standard Pay and Reimbursement Rates, DoN, FY04
[26] telephone conversation with Mr. John Hume
[27] ibid

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IV. NON-FINANCIAL CONSIDERATIONS

A. CAPABILITY CONSIDERATIONS

HSVs, due to their nature as a transportation platform, lend themselves to a variety of military missions without having to undergo large re-construction. In 2000, the US military chartered the HSV-X1 *Joint Venture* from the Australian manufacturer Incat. This vessel is essentially the same as the *WestPac Express*. The 98-m wave-piercing catamaran underwent six weeks of modifications to allow it to meet military specifications.[28] *Joint Venture* is to serve as a test for HSV technology and how its application can benefit the US military. The results have been good:

-In July 2002, during Fleet Battle Experiment Juliet, HSV-X1 served as a test platform for Navy Medicine to evaluate its suitability as a patient transport platform. Potential missions include intra-theater patient evacuation, en route care, health service support logistics, humanitarian assistance, noncombatant evacuation operations, Casualty Receiving Treatment Ship, disaster relief, Chemical, Biological and Radiological use and telemedicine. Although the ship had to reduce speed in heavy seas to produce a smoother ride, initial results warrant further exploration in the future. [29] The Navy's current hospital ships *Mercy* and *Comfort* are too big, too slow, and too vulnerable to be forward positioned. HSVs can act as a link between scarce airborne lift (fast, but virtually no patient care) and hospital ships positioned in a safe location. In comparison, a C-17 can carry 36 patient litters (patients on stretchers) and 54 ambulatory patients and attendants.[30]

-In 2003, HSV-X1 completed the first circumnavigation of the globe by a US-flagged HSV.

-During Operation Iraqi Freedom, *Joint Venture* served as a mother ship to US Special Forces clearing the waterways to Umm Qasr. This helped reduce mission time by four days by shortening the transit to re-supply. [31]

Indeed, HSV-X1 has proven so useful that the US military has acquired a second vessel: HSV-X2. HSV-X2 *Swift* will serve as a mine warfare mother ship, replacing the now decommissioned *USS Inchon*. She was handed over by Incat to the US Navy in a ceremony at the construction facility in Hobart on August 14, 2003.[32] Evaluation of the

[28] Global Security.org web site
[29] Marks
[30] AF fact sheet
[31] Dao
[32] Defense Daily International

HSVs suitability as a mine-warfare platform is ongoing. However, much emphasis is being placed on modular capabilities that can be removed when required elsewhere. If the Mine Warfare Command decides on a modular capability as opposed to HSVs specifically built as mine warfare ships, then this would aid creation of an HSV logistic fleet. Depending on the mission, MSC HSVs could bring up supplies or be turned over to mobile mine warfare units to secure sea lines of communication.

B. OTHER WESTPAC EXPRESS BENEFITS

Okinawa residents are ill at ease with the American military presence. III MEF estimates that the use of the *WestPac Express* eliminated more than 200 AMC flights out of Kadena airport, thus reducing noise pollution in the surrounding civilian areas. Furthermore, Okinawa suffers from traffic congestion.[33] The ability of the *WestPac Express* to load at Kin Red pier near the American forces has reduced the burden of American military presence on the civilian population. Large convoys of troops and materiel, rather than being required to travel to Kadena airport or Naha port through the heavy Okinawa traffic, can now load at base facilities.

Though this scenario seems unique to Okinawa, the military impact on civilian life is becoming a growing concern as the US becomes more densely populated. Current and past issues include jet noise complaints in Virginia Beach, conducting routine military convoys at night on the German autobahn instead of during the day, and encroachment of planned civilian communities in California on military air lanes. Furthermore, congestion in the US transportation infrastructure continues to grow, especially in rail, highway and air transportation modes.[34] The creation of HSV service may offer forward thinking use of the only comparatively under-used mode of US transportation: sea transport.

C. INDUSTRIAL BASE CONSIDERATIONS

The US shipbuilding industry has been in a steady decline since the end of World War Two. Essentially it exists only to serve the domestic market and military sales. As the US Navy has downsized, so has the shipbuilding industry. The reasons for the decline are many, but can be reduced to two factors: inability to compete on price and failure to produce true innovation.[35]

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[33] NWDC web site
[34] Tuttle & Wykle, pg 54
[35] Zoccola

The market leaders in HSV technology are two Australian firms: Austal and Incat. They have captured a large fraction of the international fast ferry market. However, commercial growth is expected to continue. First, demand for ferries is increasing as world population and world trade grow, especially in the littorals. Second, in a related development, traditional transportation networks such as railways, highways, and airfreight require increasingly large capital investments for incremental growth in capacity. Under these circumstances, sealift becomes increasingly attractive because it already is the most cost-effective transportation mode and suffers from less congestion.[36] Third, as HSVs become faster and larger, their usefulness increases.

Austal and Incat are poised to take advantage of this increased demand. However, to participate in the lucrative US defense market, they have had to transfer technology and construction capability to the US. DoD and Congress prefer allocating defense contracts to American companies in order to protect the country's industrial base as well as garner local political support. Thus, by setting up shop in the U.S., these Australian companies can circumvent many of their American competitors' objections. Both Austal and Incat can produce three HSVs per shipyard per year.[37] They have teamed up with Bender Marine and Bollinger respectively and created production facilities in the US. These shipyards can construct another three vessels a year each. Furthermore, this infusion of technology and capital is creating American jobs and lays the foundation for an American shipbuilding industry with something to offer to the international market. For further discussion, see Appendix A.

D. DIPLOMATIC CONSIDERATIONS

Australia has been one of the staunchest US allies. Partnering with the Australian companies Austal and Incat will help cement our alliance even further. It is a signal that even small allies can successfully contribute to the collective defense of the free democracies. It also underscores the benefits of supporting the US internationally.

E. TECHNOLOGY RISK

If the HSV is adopted as a transportation solution, the technology risk is low. High Speed Ferries like the *WestPac Express* have been constructed for more than a decade. The true risk lies in the militarization of a civilian capability. If force planners use this tool outside its original design parameters, costs will escalate. However, as long as the HSV is used as a transportation platform, with additional capabilities being fitted

[36] Tuttle & Wykle, pg 54

to it as opposed to the HSV having to fit military desires, then technology risk should remain very low. The military designs currently considered from Austal and Incat show a vessel that meets most current requirements without eliminating its root mission as a transportation device. As specialized requirements continue to grow, so will technology risk, and hence cost.

F. CRFF

The Civil Reserve Air Fleet (CRAF) has acted as a force multiplier for the Air Force. For moving people and freight, civilian airlines have assets that can easily augment military transportation capabilities. The price is subsidies in the form of favorable contracts during peacetime. The Voluntary Intermodal Sealift Agreement (VISA) has created a similar situation in the area of sealift. With the expansion of HSV uses, MSC could conceivably create the Civil Reserve Ferry Fleet (CRFF). This would give DoD the option to call HSVs operated by US companies into military service in time of war to augment fast sealift.

G. SURVIVABILITY

Any comparison with the C-17 would not be complete without addressing survivability. Neither C-17 nor HSVs are designed as front-line combat units. They provide logistic support to relatively secure areas. Neither should be expected to handle a direct engagement with enemy aircraft or surface combatants.

The C-17 may face danger on the ground, primarily by enemy Special Forces or terrorists. Mortar fire or any other explosive device could damage the aircraft. However, it can be expected that a C-17 airfield will have perimeter security. The greatest danger would come from shoulder-fired missiles launched as the C-17 is either landing or taking off. If such a launch were successful, the result would be complete loss of aircraft and cargo.

An HSV is much more robust. Shoulder-fired missiles could cause damage, but the damage would not likely be catastrophic. The hull form allows for easy surveillance and the shallow draft makes it easy to check for swimmer mounted explosive devices such as limpet mines. The Mine Warfare Command is currently evaluating the usefulness of HSVs as mine hunters. The aluminum hull virtually eliminates a magnetic signature for the ship, thus eliminating the threat from magnetically triggered mines. The shallow draft catamaran hull should both reduce the area a contact mine can hit as well as

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[37] telephone conversation with Mr. John Hume

the pressure wave an influence mine would require for detonation. Finally, the high speed of the HSV (42 knots) makes target motion analysis by enemy submarines (a submerged diesel submarine typically travels at 6 knots) very difficult. Unless the HSV travels directly toward the submarine without zigzagging, it should have a good chance at evasion. If a submarine did launch a torpedo, it would have to be close. Most torpedoes travel at about 50 knots and, therefore, do not have a significant speed advantage over the HSV.

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V. MARKETING PLAN AND CONCLUSION

A. DEVELOPING A MARKETING STRATEGY

Within the next five years, we believe MSC should institutionalize HSV service in the III MEF Area of Responsibility (AOR) and investigate the expansion of the service into other theaters of operation. A global HSV service with additional presence on the East Coast, the West Coast, the Mediterranean, and the Arabian Gulf should be considered.

MSC has a new service in the growing defense transportation market. The HSV can rapidly move battalion-sized units and their equipment within a radius of 1500 nautical miles. All that is required is about 15 feet of water and a pier. It accomplishes this more cost-effectively than AMC airlift. Additionally, it offers the theater commander a flexible asset that can serve as a mine hunting platform, a special warfare mother ship, a floating hospital, or an emergency re-supply platform for humanitarian efforts. The HSV is a force multiplier in that it reduces the cycle-time of in-theater joint and coalition forces as they move from garrison to staging area. Operation Iraqi Freedom again demonstrated that US military forces couldn't be deployed as fast as decision makers would like them to. Though the HSV is not the cure, it can narrow the gap between current logistical capabilities and a desired future.

B. MARKETING IMPLEMENTATION

To market HSV service throughout DoD, MSC might build an HSV office that can fully support the institutionalization of the service in the III MEF AOR and further its expansion into other maritime theaters. This HSV office should be able to accomplish the following: marketing, contract administration, manning, support, service liaison, and sales.

1. Marketing: The marketing function requires the travel of MSC staff to theater commanders and educating them about the HSV capability. For example, III MEF views the *WestPac Express* primarily as a people mover. It will serve as an important mobilization asset in case of hostilities with North Korea, thus allowing a quick movement of fighting units from Okinawa to South Korea. 5th Fleet might use the HSV to support CENTCOM. The vessel could routinely shuttle personnel and supplies between Iraq, Kuwait, Bahrain, Qatar, UAE and afloat units – a sort of super "Desert Duck" " (the fleet's name given to the current logistic support shuttle: old H-3 helicopters). EUCOM might be interested in using the HSV as a logistical support unit for US forces stationed in the Balkans with constant runs from Italy to Croatia. The HSV could also support exercises throughout the Mediterranean and the Black Sea. PACOM could use an HSV to re-supply bases on Pacific atolls from Guam or Hawaii. Finally NORCOM might find useful an HSV that can move heavy equipment rapidly up and down the East Coast, thus bypassing a congested I-95. The goal should be an organic theater logistic support asset, maintained by MSC and paid for by the customer.

2. Contract Administration: This function would involve leasing HSVs from the builder. These MSC personnel would let request for proposals and administer the contracts. It would also involve the disposal of surplus units and perhaps oversight of a possible CRFF.

3. Manning: The manning function would be responsible for hiring and training the civilian mariners manning the HSVs. It would also oversee force protection requirements.

4. Support: This function would oversee O&M accounts for the HSV fleet. Also, it would ensure accountability and support of any future expansion modules, for example, medical equipment to be installed in a hospital HSV, or pressure chambers for a mobile diving unit.

5. Service Liaison: This function would negotiate the scheduling of HSVs for extra-Theater requirements. For example, for the HSV to serve as a mine warfare platform, it would require manning and operation by Naval personnel. The Liaison function would schedule the mine training and allow for the turnover of the asset to Navy active or reserve crews. Also, in case of a theater conflict, the liaison function could marshal HSVs from other theaters to augment a Combatant Commander's logistic capability.

6. Sales: The Sales function would assist in the marketing and sale of HSVs to foreign militaries as well as US civilian operators. For example, a US ferry service might be interested in purchasing military type HSVs which could be entered into the CRFF for a subsidy or favorable DoD contracts. Or a Caribbean island nation might require assistance in obtaining a used MSC HSV.

C. HSV OFFICE COST ESTIMATE

Many of the above functions are routine within MSC. A team of ten to fifteen should be able to handle the initial workload of an institutionalized HSV service.

D. THE FUTURE

Technology is rapidly changing the way in which the war-fighter operates. DoD must continually embrace this change and seek technologies that will be advantageous to the war-fighter. As mentioned previously, much of this emerging technology is commercial off the shelf (COTS). COTS technology allows DoD to use systems made for the commercial sector without having to pay high costs of research and development.

Aluminum vessels are fast because they are considerably lighter than iron vessels and experience less drag than mono hulls.

> Early model testing indicates that fully loaded speeds of 60 knots are achievable, with the research team working towards speeds approaching 100 knots. A self-powered research model was tested in late 1999. Estimated speed reached by the craft is 60 to 70 knots, with centre bow clear of the water, and water resistance approaching nil. Incat has been working on adaptations to the designs for military and coastal surveillance applications. [38]

Cost of operation is lower because lighter ships don't require as much fuel. Also, aluminum ships do not rust. Aluminum vessels have a lower life-cycle cost because they require less maintenance as compared to steel vessels. However, aluminum can be susceptible to cracking and corrosion around welds.[39]

Not only has the shape of vessels changed, but also the technologies within ships themselves have also changed considerably. Technological advances have reduced the number of watch standers required onboard many vessels. For example, a crew of four can operate the *Joint Venture* or the *WestPac Express*: a helmsman, a navigator, an engineer, and an engineering roving watch. [40] Engineering spaces can be monitored and controlled from gauges and surveillance systems located on the bridge. Electronic Navigational Charts coupled with Electronic Chart Displays have come to the forefront to give mariners accurate, real-time navigation information. These systems help mariners avoid catastrophes such as groundings and collisions. They are also necessary to allow the safe operation of these ships at high speeds.

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[38] Incat web site
[39] O'Neil
[40] LT Strenge, USN

On the design front, in addition to the current 98-m military concept, Incat has plans for a 112-m variant that will allow it to offer a larger, more capable platform to both military and commercial customers.

> The craft will provide high deadweight capacities operating in higher sea state conditions at 40 knot speeds [with an operating weight of 1000 deadweight tones] delivering high payload faction. Axle load limits are increased, vehicle deck clearances are raised and total deck area is maximized through innovative use of hoistable mezzanine vehicle decks, significantly boosting the vessel's operating profile.[41]

Further technology initiatives include the construction of trimarans. "In August 1998, the UK Ministry of Defence awarded a contract to Vosper Thornycroft to construct the Trimaran, called RV (Research Vessel) Triton. The vessel was launched in May 2000 and delivered in August 2000."[42]

Though the design is being evaluated as a possible alternative for Britain's Future Surface Combatant (FSC), extrapolation to a fast sealift platform is possible. What seems clear is that mono-hulls appear to have reached their physical limitations, i.e. refinements in hull form are no longer able to achieve significant speed advantages. On the other hand, a catamaran, a trimaran or a pentamaran design allows for a reduction of hull surface area in contact with water, thus reducing drag. Increases in speed result and

[41] Incat web site

a new era in Naval Architecture appears to dawn. Indeed, Incat is currently constructing a 120-m passenger ferry![43]

E. CONCLUSION

III MEF experience with the *WestPac Express* indicates that this is a capability desired by commanders. We believe MSC, as DoD's maritime logistics provider, should take the initiative and institutionalize HSV service within major theaters of operation. These vessels offer potential cost and time savings vis-à-vis traditional AMC airlift when used within an operational radius of 1,500 nautical miles and high utilization rates. If implementation of this service could reduce DoD's proposed C-17 buy by two aircraft, the program would be paid for and allow for service with III MEF, within the Mediterranean, within the Arabian Gulf/Red Sea, along the West Coast/Hawaii and the East Coast/Caribbean. MSC should market this service to individual theater and component commanders since each customer's requirements will differ. However, HSVs are flexible enough to meet a variety of needs, now and into the future.

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[42] Defense Industries
[43] Zilles

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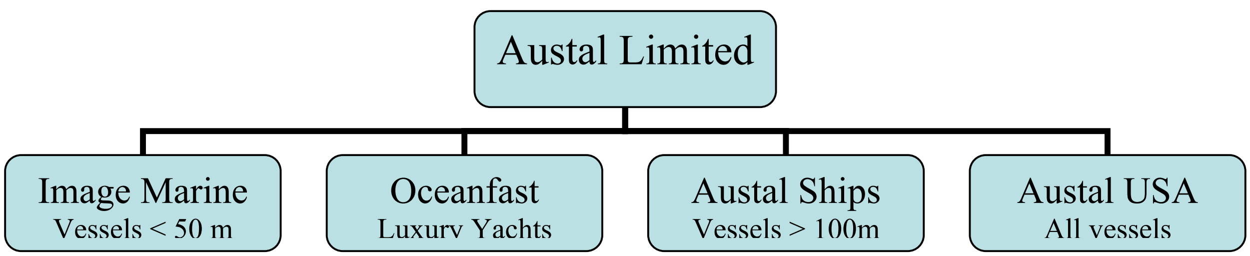
APPENDIX A
HSV INDUSTRY

The shipbuilding industry is as international and varied as they come. However, in the field of HSVs, Australia is a distant first, with two companies as champions of this new technology. Austal and Incat control approximately 70% of the HSS market.

A. AUSTAL

Austal Limited is an Australian shipbuilder that specializes in the construction of aluminum high-speed passenger and cargo vessels for the commercial sector. It consists of a diverse group of shipbuilding subsidiaries that include Austal Ships, Austal USA, Oceanfast and Image Marine. Established in 1988, Austal has grown quickly to keep up with the demand for specialized HSF. Austal-manufactured ships are currently operating worldwide. As the largest manufacturer of HSFs, Austal custom builds each vessel to conform to the specifications demanded by its clients.

Figure 2 Austal Ltd.



In 1999, Austal USA was created in Mobile, Alabama in partnership with Bender Shipbuilding and Repair. This partnership allows Austal to supply aluminum high-speed ships to a wide-open American market. Austal USA began its production line in 2001 and has since manufactured 3 vessels.[44] The Jones Act, which requires commercial vessels operating within the US be built in the US, was the primary reason for Austal's partnership with Bender. As of Feb 1, 2003, Austal USA had three contracts pending for a total of four high-speed catamarans and one high-speed ferry. The estimated value of these contracts is upward of 145 million dollars.[45] Austal USA allows Austal to penetrate the US commercial market and also get a leg up on the competition in the military market based on the current interest expressed by DoD.

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[44] Wiedemann
[45] Marine Log, March 2003, p 56

A military market for HSFs emerged after the Royal Australian Navy's successful deployment of HMAS Jervis Bay. Although Austal did not build Jervis Bay, it was in a good position to offer its ships to DoD. Austal CEO John Rothwell, in a 2002 interview said, "We see the military needs for high speed vessels, particularly in the US as being a substantial market." Austal has diversified their product base with the acquisition of their current subsidiaries, but they definitely seem poised to market their vessels to the US military. Rothwell went on to say, "I have great confidence in our future with military vessels."[46] In July 2003, the US Navy awarded 1 of 3 contracts to General Dynamics to conduct a preliminary design for the Littoral Combat Ship (LCS). General Dynamics, which is teamed with Austal USA, based its proposal upon Austal's 126-meter, high-speed aluminum trimaran hull form.[47]

B. INCAT

Incat, based in Hobart, Tasmania, is an Australian company that specializes in the construction of High Speed Vessels. Whereas Austal builds only to order, Incat follows a more speculative model. This speculative model, i.e. build the ship first, then sell it, has caused Incat to build up a sizeable debt burden. Indeed, the company has been in receivership. However, the initiative may be paying off in that Incat has captured the majority of military contracts so far (only *WestPac Express* is Austal-built). Incat has built over 40 percent of HSVs longer than 70 meters in existence in the world.[48]

Incat has partnered with Bollinger Marine of Louisiana to set up production facilities in the US. This will both increase the production capability and overcome US regulatory obstacles in the acquisition of foreign-made defense systems. Technology transfer is underway. Currently, Incat can build three HSV-type ships at Hobart per year. Within a year or two, Bollinger should be able to match that production capacity. [49]

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[46] Wiedemann
[47] Marine Log, August 2003, p. 5
[48] Incat web site
[49] Baumgardner

APPENDIX B
U.S. ARMY EFFORTS

The Army, with the Tank and Automotive Command (TACOM) in the lead, has taken a different approach to HSV acquisition. HSV is seen as a solution to moving Stryker brigades more quickly.

The Army experienced great success on the Battlefield, but both Afghanistan and Iraq seemed to demonstrate an inability by the Army to project credible combat power as fast as decision makers would have liked. In keeping with the theme of force transportation, which is seeking lighter, more mobile forces, the Army developed the Stryker Interim Brigade Combat Team (IBCT). The goal is to create a force of six IBCTs built around the Stryker Light Armored Vehicle, which fits into a C-130. This would allow for a faster force.

As an extension of this, the Army determined a need for 12 Theater Support Vessels (TSVs), to move the Brigade quickly. They will replace the current fleet of General Frank S Besson, Jr.- class Logistics Support Vessels.[50] Even with the Stryker fitting into a C-130, the size of the organization is such that sealift is still preferable. HSVs would allow a compromise solution. The Brigade could be moved more quickly than conventional forces using traditional sealift, yet without absorbing AMC's entire airlift. Further, by naming the vessel a TSV, no challenge to the Air Force's strategic mobility role is presented.

The first TSV has been chartered by TACOM in November 2002. The *Spearhead* will be based at Diego Garcia. [51]

[50] *Incat-Bollinger Team Delivers HSV-2 Swift To The Navy*, pg.1.
[51] Proceedings, April 2003, pg 104.

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APPENDIX C
EXECUTIVE STEERING COMMITTEE

In September of 1998, a High Speed Sealift/Agile Port Executive Steering Committee (HSS/AP ESC) was created. Members include USTRANSCOM, Deputy Chief of Naval Operations N4/N42, Headquarters Department of the Army DCSLOG/DCSOPS, Maritime Administration, Headquarters U.S. Marine Corps, NAVSEA PEO EXW, and Industry. The primary purpose of the Executive Steering Committee is "to serve as a forum for stimulating innovation for engineering and material solutions to the nation's high speed strategic sealift/agile port efforts."[52]

HSVs fall under the aegis of the committee. A HSS/AP AOG (Action Officers Group) has been formed and the respective action officers meet monthly to discuss issues and share information. However, the evolution of the technology is now prompting plans for a HSS (High Speed Shipping) Technology Office.[53] To further coordinate efforts, on 14 Aug 2003, the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics (OSD AT&L) submitted a memorandum to the Assistant Secretary of the Army (Acquisitions, Logistics and Technology) and Assistant Secretary of the Navy (Research, Development and Acquisition) asking them to formalize coordination between their respective PEOs involved in High Speed Sealift research, development and procurement.

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[52] MOA HSS/AP ESC
[53] Meeting Minutes, HSS/AP AOG, 28 July 2003

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APPENDIX D
SWOT ANALYSIS

A SWOT analysis is important to maintain focus on key issues. It is an effective way to evaluate the internal strengths and weaknesses, as well as external opportunities and threats facing HSV as a new DoD transportation initiative. This framework provides a great place to begin analysis of HSV.

Strength

The strengths associated with HSV technology are varied in their composition, but all are important to the customer. It is the strengths of this platform that have garnered it DoD attention.

This project's analysis shows that HSV offers a cost savings and some time savings over comparative airlift as offered by AMC. *WestPac Express* saved $8.7 million compared to an estimated AMC cost of $20.7 million in FY03. Time savings is seen when positioning a battalion of men and equipment less than 1500 miles. The equivalent would take 14-17 days to move if accomplished by airlift.

Because *WestPac Express* is an organic asset controlled by the user and managed by MSC, USMC can count on better responsiveness than with airlift. Currently, the U.S. is engaged in the war on terror and the war in Iraq, and the majority of strategic airlift is unavailable to conduct routine intra-theater airlift for training. Thus, it is extremely difficult to schedule airlift with certainty. *WestPac Express* is extremely important for III MEF's ability to train.

The HSV is flexible. It has an open cargo hold that allows for 33,000 square feet of cargo space. It is able to carry a battalion-sized unit and equipment. The continuity between troops and their gear is excellent with HSVs. Troops arrive at their destination ready to fight. In addition, these vessels can be outfitted to serve a variety of functions such as: hospital ship, cryptology suites for signals intelligence, Special Forces mother ship, etc. The ability to adapt and allow such wide employment flexibility is unique to this type of vessel.

The maneuverability of HSV is remarkable. HSVs are the fastest sealift available. Some vessels have the ability to travel at sustained speeds up to 50 knots. *WestPac Express*, loaded to capacity is able to sustain 32 knots. Its shallow draft of 14 feet offers access to most world ports. Furthermore, the water jet propulsion system negates the need for tugs or line handlers; the ship's crew can moor pier side unassisted.

Weakness

Currently, HSV is a transportation solution only. It is not suited for a combat environment. These vessels have aluminum hulls that make them lighter than traditional warships. This vessel is built for speed, not combat survivability. Its aluminum hull makes it more vulnerable than an iron ship. Moreover, with the exception of HSV-X2 *Swift*, these vessels are not equipped with any self-defense capabilities.

HSVs require port facilities and infrastructure to embark and disembark troops and equipment. HSVs are currently unable to disembark equipment at sea. The ramp configurations of some HSVs also make them less flexible, requiring certain mooring positions for embarkation and debarkation of equipment.

HSVs are most cost-effective when transporting equipment fully loaded. The more equipment transported, the less money this mode costs as compared to airlift.

Weather conditions can also be prohibitive to HSV operations. Shallow draft and large sail area make HSVs susceptible to damage from high winds pier side. Underway, *WestPac Express* is unable to face 4m seas without the possibility of damage.

These vessels have yet to be modified to conduct alongside underway replenishment.

Opportunity

HSV is an excellent opportunity to take advantage of commercial off-the-shelf technology (COTS). DoD can dramatically reduce non-recurring costs such as research and development costs, procurement, military construction costs, and technology investment costs when it buys these vessels.

Even if DoD were set on buying these vessels, the cost is relatively low as compared to a naval warship at $70 to $100 million. The option is there however to lease these vessels. DoD is currently leasing *WestPac Express*, *Spearhead*, *Joint Venture*, and *Swift* from Incat and Austal.

HSV has the ability to quickly deliver heavy material and could support transformation initiatives such as Sea Basing and Sea Enterprise. It also coincides with cutting-edge logistical concepts such as focused logistics, agile logistics, and velocity management.

The design of HSVs is such that allows it to be adaptable and could potentially support missions such as Mine Warfare, Naval Special Warfare, Non combatant

Evacuation Operations, Humanitarian Assistance, Command and Control, Maritime Interdiction Operations, Homeland Security, Anti Terrorism Operations.

Threat

HSV technology is relatively new. As a result, its technological risk will undoubtedly evolve. These vessels would have to integrate with existing military capabilities and organization priorities. HSVs would operate with current military ships using existing doctrine that may not complement its capabilities.

The Army, Navy, and Marine Corps are all interested in the capabilities of HSV. The priorities of these services will be different and the roles these vessels assume depend on which service they go to. Additionally, it is possible that AMC will feel threatened by HSVs' ability to move intra-theater cargo rapidly.

Mission creep is a valid concern that has plagued many DoD acquisitions. Military modifications may take HSV beyond its initial commercial configuration, resulting in high costs that could reduce its attractiveness as well as civil-military flexibility.

Failure to implement these vessels into military service may result in lost opportunities for DoD. These losses may take the form of money, capabilities, technological advancement, and time.

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APPENDIX E

SPREADSHEETS

HSV Monthly Costs FY02 and FY 03[54]

HSV monthly cost
FY 02

FY 02

	HSV		**Estimated AMC**	Cost/mile	**Pass Miles & Cargo Miles**	
Feb	Charter	$400,000				
	Fuel	$221,365	PAX Cost	$254,034	PAX mile	1,119,938
	Port Cost	$59,331	CARGO Cost	$751,524	CARGO mile	1,755,724,000
	Total	$680,696	Total	$1,005,558	Total	1,756,843,938
Mar	Charter	$775,000				
	Fuel	$362,033	PAX Cost	$431,817	PAX mile	1,903,711
	Port Cost	$59,331	CARGO Cost	$1,251,992	CARGO mile	2,924,928,000
	Total	$1,196,364	Total	$1,683,809	Total	2,926,831,711
Apr	Charter	$750,000				
	Fuel	$523,544	PAX Cost	$537,848	PAX mile	2,393,160
	Port Cost	$59,331	CARGO Cost	$1,464,982	CARGO mile	3,422,519,600
	Total	$1,332,875	Total	$2,002,830	Total	3,424,912,760
May	Charter	$775,000				
	Fuel	$328,495	PAX Cost	$442,504	PAX mile	1,950,828
	Port Cost	$59,331	CARGO Cost	$4,367,927	CARGO mile	2,575,892,600
	Total	$1,162,826	Total	$4,810,431	Total	2,577,843,428
June	Charter	$750,000				
	Fuel	$322,814	PAX Cost	$450,700	PAX mile	1,986,958
	Port Cost	$59,331	CARGO Cost	$1,422,098	CARGO mile	3,322,332,000
	Total	$1,132,145	Total	$1,872,798	Total	3,324,318,958
Jul	Charter	$750,000				
	Fuel	$219,415	PAX Cost	$0	PAX mile	-
	Port Cost	$59,331	CARGO Cost	$276,264	CARGO mile	645,414,000
	Total	$1,028,746	Total	$276,264	Total	645,414,000
Aug	Charter	$775,000				
	Fuel	$201,217	PAX Cost	$293,665	PAX mile	1,294,655
	Port Cost	$59,331	CARGO Cost	$619,885	CARGO mile	1,448,118,000
	Total	$1,035,548	Total	$913,550	Total	1,449,412,655

[54] Cost Data provided by MSC.

Sep	Charter	$225,000				
	Fuel	$41,036	PAX Cost	$32,936	PAX mile	145,200
	Port Cost	$59,331	CARGO Cost	$109,921	CARGO mile	256,800,000
	Total	$325,367	Total	$142,857	Total	256,945,200

HSV monthly cost[55]
FY 03

FY 03

	HSV		**Estimated AMC Cost/mile**		**Pass Miles & Cargo Miles**	
OCT	Charter	$775,000				
	Fuel	$224,384	PAX Cost	$530,050	PAX mile	2,065,666
	Port Cost	$67,396	CARGO Cost	$1,991,755	CARGO mile	2,978,994,000
	Total	$1,066,780	Total	$2,521,805	Total	2,981,059,666
NOV	Charter	$750,000				
	Fuel	$286,667	PAX Cost	$580,083	PAX mile	2,260,652
	Port Cost	$67,396	CARGO Cost	$2,391,753	CARGO mile	3,577,256,000
	Total	$1,104,063	Total	$2,971,836	Total	3,579,516,652
DEC	Charter	$775,000				
	Fuel	$173,923	PAX Cost	$167,355	PAX mile	652,200
	Port Cost	$67,396	CARGO Cost	$633,030	CARGO mile	946,800,000
	Total	$1,016,319	Total	$800,385	Total	947,452,200
JAN	Charter	$775,000				
	Fuel	$65,190	PAX Cost	$144,491	PAX mile	563,098
	Port Cost	$67,396	CARGO Cost	$476,812	CARGO mile	713,150,000
	Total	$907,586	Total	$621,303	Total	713,713,098
FEB	Charter	$739,648				
	Fuel	$241,668	PAX Cost	$368,169	PAX mile	1,434,797
	Port Cost	$67,396	CARGO Cost	$1,320,582	CARGO mile	1,975,144,600
	Total	$1,048,712	Total	$1,688,751	Total	1,976,579,397
MAR	Charter	$862,792				
	Fuel	$393,810	PAX Cost	$424,337	PAX mile	1,653,692
	Port Cost	$67,396	CARGO Cost	$1,477,380	CARGO mile	2,209,661,600
	Total	$1,323,998	Total	$1,901,717	Total	2,211,315,292
APR	Charter	$834,960				
	Fuel	$238,929	PAX Cost	$666,087	PAX mile	2,595,818
	Port Cost	$67,396	CARGO Cost	$2,129,875	CARGO mile	3,185,575,000
	Total	$1,141,285	Total	$2,795,962	Total	3,188,170,818

[55] A weighted average was used to calculate FY 03 Port Costs from known port charges.

MAY	Charter	$834,960				
	Fuel	$325,740	PAX Cost	$739,148	PAX mile	2,880,545
	Port Cost	$67,396	CARGO Cost	$2,262,718	CARGO mile	3,384,263,000
	Total	$1,228,096	Total	$3,001,866	Total	3,387,143,545
JUN	Charter	$834,960				
	Fuel	$462,656	PAX Cost	$416,366	PAX mile	1,622,625
	Port Cost	$67,396	CARGO Cost	$2,782,145	CARGO mile	4,161,149,600
	Total	$1,365,012	Total	$3,198,511	Total	4,162,772,225
JUL	Charter	$695,800				
	Fuel	$37,089	PAX Cost	$0	PAX mile	0
	Port Cost	$67,396	CARGO Cost	$0	CARGO mile	0
	Total	$800,285	Total	$0	Total	0
AUG	Charter	$862,792				
	Fuel	$125,453	PAX Cost	$291,758	PAX mile	1,137,013
	Port Cost	$67,396	CARGO Cost	$697,923	CARGO mile	1,043,858,000
	Total	$1,055,641	Total	$989,681	Total	1,044,995,013
SEP	Charter	$869,648				
	Fuel	$205,890	PAX Cost	$118,742	PAX mile	462,753
	Port Cost	$67,396	CARGO Cost	$129,230	CARGO mile	193,284,000
	Total	$1,142,934	Total	$247,972	Total	193,746,753

Lease vs. Buy Analysis

Lease								
	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09
Charter (Fixed)	$5,150,000	$9,392,552	$9,930,000	$9,900,000	$9,900,000	$9,900,000	$9,930,000	$9,900,000
Variable	$2,694,650	$3,590,151	$3,691,746	$3,555,319	$3,586,193	$3,617,068	$3,657,174	$3,674,754
Overhead	$313,786	$519,308	$544,870	$538,213	$539,448	$540,683	$543,487	$542,990
Total	$8,158,436	$13,502,011	$14,166,616	$13,993,532	$14,025,641	$14,057,751	$14,130,661	$14,117,744
Est. Savings	$1,170,982	$7,237,778	$6,573,173	$6,746,257	$6,714,148	$6,682,038	$6,609,128	$6,622,045
Benefits	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000
Difference	$4,987,454	$4,264,233	$5,593,443	$5,247,275	$5,311,492	$5,375,712	$5,521,533	$5,495,699
NPV	$5,918,775	$3,876,576	$4,622,680	$3,942,355	$3,627,821	$3,337,894	$3,116,761	$2,820,163
NPV Total	$5,918,775	$9,795,351	$14,418,031	$18,360,386	$21,988,206	$25,326,101	$28,442,862	$31,263,025
Purchase	$100,000,000	$0	$0	$0	$0	$0	$0	$0
Personnel	$840,000	$1,260,000	$1,260,000	$1,260,000	$1,260,000	$1,260,000	$1,260,000	$1,260,000
Maint	$1,545,000	$2,817,766	$2,817,766	$2,817,766	$2,817,766	$2,817,766	$2,817,766	$2,817,766
Variable	$2,694,650	$3,590,151	$3,691,746	$3,555,319	$3,586,193	$3,617,068	$3,657,174	$3,674,754
Overhead	$203,186	$306,717	$310,780	$305,323	$306,558	$307,793	$309,398	$310,101
Total Cost	$105,282,836	$7,974,633	$8,080,292	$7,938,408	$7,970,517	$8,002,627	$8,044,337	$8,062,620
Savings	$1,170,982	$7,237,778	$6,573,173	$6,746,257	$6,714,148	$6,682,038	$6,609,128	$6,622,045
Benefits	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000
Total	$102,111,854	$1,263,145	$492,881	$807,849	$743,631	$679,411	$564,791	$559,424
NPV	$103,043,175	$1,148,313	$407,340	$606,949	$507,910	$421,861	$318,810	$287,073
NPV Total	$103,043,175	$104,191,488	$104,598,828	$105,205,777	$105,713,687	$106,135,548	$106,454,358	$106,741,431
one C-17			Personnel Costs			Benefits		
Purchase	$236,700,000.00		Crew Number	14		Time	$1,000,000	
			Salary/month	$7,500		Impact	$400,000	
			Maintenance Costs			Shipbuilding	$300,000	
			Cost Factor	0.3		US-Australia	$100,000	
			Overhead Costs			Add Mine	$100,000	
			Cost Factor	0.04		Add Hospital	$100,000	
			Discount Factor	0.1		Total	$2,000,000	

Break-even Analysis

FY02			
Pmile			LbMile
Fixed	$5,150,000		$5,150,000
Price	0.226829		0.000428042
Variable	$2,694,650		$2,694,650
x	34,583,982		18,326,823,069
FY03			
Pmile			LbMile
Fixed	$9,392,552		$9,392,552
Price	0.2566		0.0006686
Variable	$3,590,151		$3,590,151
x	50,595,101		19,417,743,045
Variable-Fixed Percentage			
%	0.382233817		

Time Distance Comparison

Parameters

HSV speed	42 knots	C-17 speed	450 knots
avg HSV load time	4 hours	avg C-17 load time	1 hour/plane
mission completion success probability	0.99	mission completion success probability	0.92
maintenance hours/ engine hour	0.45 hours	maintenance hours/ flying hour	20 hours

	1	**17**	**8**	**1**	
Distance (NM)	**HSV time**	**C-17**	**C-17**	**C-17**	
100	10	34	44	56	
150	12	34	50	66	
200	13	34	55	77	
250	14	35	60	88	
300	15	35	65	99	
350	16	35	71	109	
400	18	35	76	120	
450	19	35	81	131	
500	20	35	86	142	
550	21	35	92	153	
600	22	35	97	163	
650	23	35	102	174	
700	25	36	107	185	
750	26	36	113	196	
800	27	36	118	206	
850	28	36	123	217	
900	29	36	128	228	
950	31	36	133	239	
1000	32	36	139	250	
1050	33	36	144	260	
1100	34	36	149	271	
1150	35	37	154	282	
1200	37	37	160	293	
1250	38	37	165	303	
1300	39	37	170	314	
1350	40	37	175	325	
1400	41	37	181	336	
1450	43	37	186	347	
1500	44	37	191	357	
1550	53	37	196	368	Assumption of 8 hrs HSV refueling stop
1600	54	38	202	379	
1650	55	38	207	390	
1700	56	38	212	400	
1750	58	38	217	411	
1800	59	38	223	422	
1850	60	38	228	433	
1900	61	38	233	444	
1950	62	38	238	454	
2000	64	38	243	465	
3000	95	41	348	681	Assumption of 8 hrs HSV refueling stop
4500	139	44	505	1004	Assumption of 8 hrs HSV refueling stop
5000	151	45	558	1112	

HSV formula break down
2 times the load time to simulate onload and offload +
distance divided by HSV speed

C-17 formula break down
17 is the required number of C-17s per battalion divided by the number of aircraft available *
2 times the load time to simulate onload and offload +
distance divided by C-17 speed
+
17 is the required number of C-17s per battalion minus the number of aircraft available *
distance divided by C-17 speed
+
17 is the required number of C-17s per battalion minus the number of aircraft available
divided by 5 *
distance divided by C-17 speed *
maintenance hours

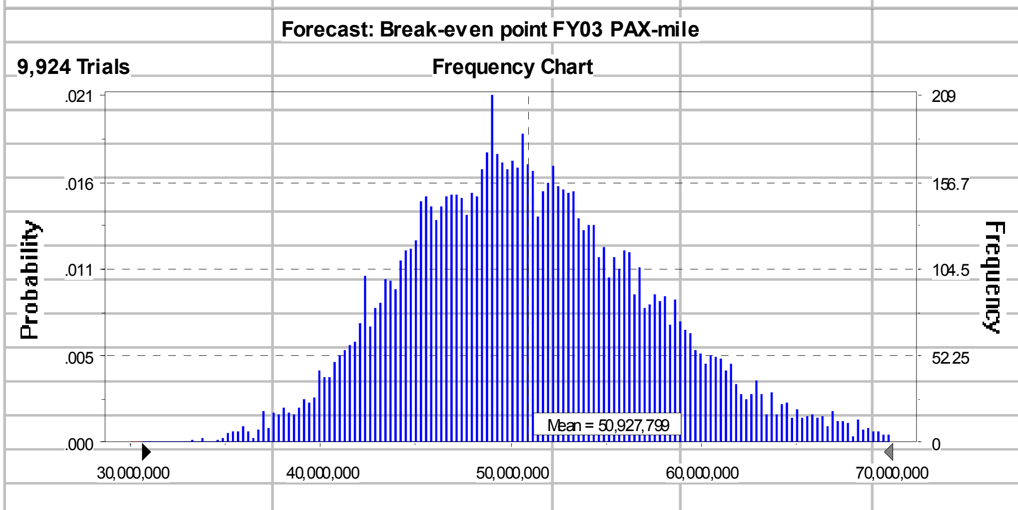
Crew Cost Comparison

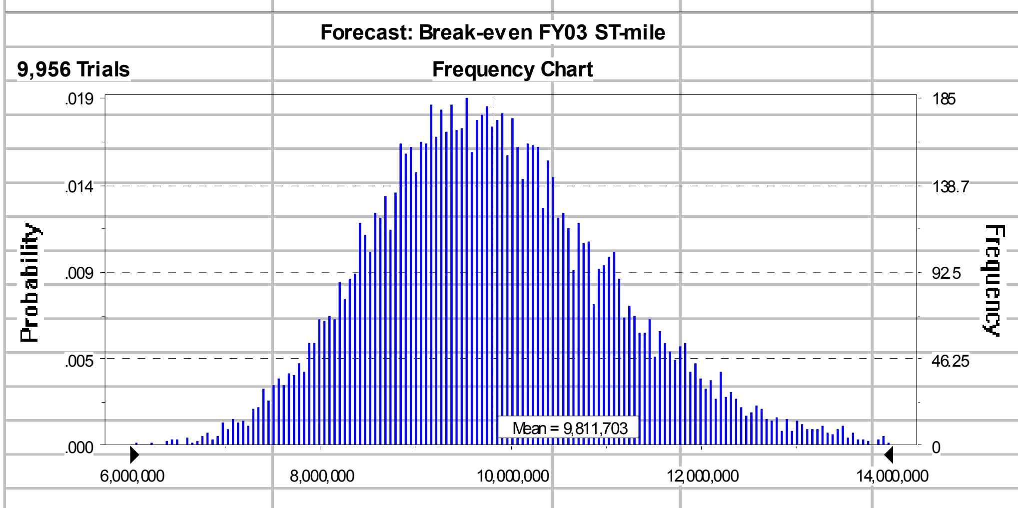
HSV - civilian crew					HSV - notional military crew			
# civilian crew	14				Number	Paygrade	Salary	Total
HSV daily crew cost	$7,913				1	0-4	$126,240	$126,240
above/person	$565.21				2	0-3	$108,199	$216,398
annual salary civ	$206,303				2	0-2	$83,672	$167,344
					3	E-7	$78,918	$236,754
					6	E-6	$68,746	$412,476
annual cost civ	$2,888,245				9	E-5	$58,127	$523,143
annual cost mil	$2,468,069				12	E-4	$48,452	$581,424
					5	E-3	$40,858	$204,290
Savings	-$420,176				40			$2,468,069

Risk Analysis

FY02					
Pmile				LbMile	
Fixed	$5,150,000			$5,150,000	
Price	0.226829			0.000428042	
Variable	$2,694,650			$2,694,650	
x	34,583,982			9,163,412	
FY03					
Pax-mile			Lb-Mile		
Fixed	$9,392,552		Fixed	$9,392,552	
Price	0.2566		Price	0.0006686	
Variable	$3,590,151		Variable	$3,590,151	
x	50,595,101		x	9,708,872	
Forecast: Break-even FY03 PAX-mile				Forecast: Break-even FY03 ST-mile	
Statistic	Value			Statistic	Value
Trials	9,924			Trials	9,956
Mean	50,927,799			Mean	9,811,703
Median	50,523,040			Median	9,726,487
Mode	---			Mode	---
Standard Deviation	6,337,350			Standard Deviation	1,244,736
Variance	40,161,999,899,883			Variance	1,549,368,125,544
Skewness	0.28			Skewness	0.35
Kurtosis	2.88			Kurtosis	3.04
Coeff. of Variability	0.12			Coeff. of Variability	0.13
Range Minimum	30,000,000			Range Minimum	6,000,000
Range Maximum	70,000,000			Range Maximum	3
Range Width	40,000,000			Range Width	8,000,000
Mean Std. Error	63,615.70			Mean Std. Error	12,474.84

Risk Analysis Graph





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GLOSSARY

long ton - A British weight, consisting of 112 pounds in the hundredweight and 2240 pounds (1016.047 kilograms) in the ton.[56]

metric ton – see tonne

short ton – A weight used in the United States, consisting of 100 pounds in the hundredweight and exactly 2000 pounds (907.185 kilograms) in the ton.[57]

ton (tn or T or t) - a traditional unit of weight equal to 20 hundredweight; see long ton and short ton

tonne (t) - metric unit of mass equal to 1000 kilograms or approximately 2204.623 pounds avoirdupois. The International System (SI) uses this French spelling for the metric ton to distinguish it clearly from the long and short tons of customary English usage. Large masses are often stated as multiples of the tonne, although technically the SI requires that masses be stated as multiples of the gram. Thus a mass of 10^3 tonnes = 10^6 kg = 10^9 g is often called 1 kilotonne (kt) instead of 1 gigagram. In the United States, the Department of Commerce recommends that the tonne be called the metric ton.[58]

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[56] Rowlett
[57] ibid
[58] ibid

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